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Wisconsin Geological Survey reports

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Geological report, 1854, <1860>

Annual report on the Geological Survey of the State of Wisconsin, 1855-1856

Report, 1857

Report of the Commissioners of the Geological Survey, <1858>

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REPORT.

To His Excellency Coles Bashford,

Governor of Wisconsin:

I herewith submit a Report upon the Geological Survey of Wisconsin, made in accordance with an act providing for the Geological Survey of the State, passed March 3d, 1857.

Since assuming the duties of my department of the Survey, I have labored diligently to promote its objects, and with such trifling exceptions as were caused by the fulfilment of duties and responsibilities previously assumed, I have devoted my whole time to the work. The entire results of the season cannot of course be given in a matured form at this early period as much of it is connected with the work of subsequent seasons, and the precise value of other portions can only be ascertained by studies which cannot be carried on in the field.

I shall therefore attempt only a report of progress and append such matter as I have thought important to be published, from its bearings upon the undeveloped resources of the State.

In undertaking a work, which according to my contract with the State, was to continue during a series of years, it seemed proper first, to ascertain precisely what had already been done in perfecting our Geology. I therefore devoted some little time to collecting whatever materials might be in existence which would be of value in this effort. These materials were scattered through the Reports of the U. S. Geologist, in unpublished notes of lines to Railroad surveys, and in the annual Reports of other State Geologists, for the years 1854–'55 and '56.

I had also considerable material of my own gathered from time to time incidentally in my travels over the state. These scattered materials I endeavored to arrange and compile so as to indicate the stage of advancement already attained towards understanding the Geology of Wisconsin.

Thus what had been done, and what still remained to do, could be seen at a glance, and a chart was furnished from which valuable hints could constantly be drawn by the explorer.

Such a review of the ground was a pre-requisite to the economical conduct of the survey as it would save the repetition of studies already faithfully performed and point out at once the unexplored fields of investigation which remained.

In prosecuting my work, as well as in its organization, I have endeavored to keep in view the circumstances under which this survey has been initiated.

It is in a new state whose population is sparse, whose territory is of vast extent and much of it in a state of nature and whose resources are yet to be found out and developed. The condition of its treasury admits of no large expenditure for objects which are not of immediate necessity or followed by a prompt return in kind. It would be obviously impossible under any appropriation that the State could afford to make to visit every section of land within its limits, examine minutely its soil, its rocks, and every circumstance which might be of interest to the geolgist. Such a survey could only be wisely undertaken by a rich and densely populated country.

We have an example of this kind in the very thorough and minute geological survey of Great Britain, which is still in progress, and is a splendid model of its kind, both in the perfection of its organization and the masterly ability with which it is being prosecuted.

Yet it would be absurd for us to attempt an imitation of that noble survey in detail. Our entire appropriation would scarcely sustain the work over a single township, and the present generation would pass away, while half the state still remained unexplored.

In a new and unsettled state, with an extensive territory, a widely different policy must govern.

The geologist should aim: 1st. To grasp and present clearly, the great geological features of his district, and the prominent physical resources which it contains.

2d. To study minutely those points only which promise the richest economical and scientific results, and to study these as a general rule in the order of their relative importance, so far as this can be known by a cursory survey.

3d. To present the knowledge thus obtained in such form as to be intelligible to every citizen of the state or to those abroad who may be interested in its geology, or the development of its resources.

While this plan of action may be less satisfactory to the Geologist and less favorable to his reputation than researches prosecuted more regularly and minutely, it seems to me the only one at all compatible with the idea of bringing rapidly into notice the resources of a new State, and furnishing to its inhabitants, who are now living, a general chart of its geology.

My work during the past season has been prosecuted in the light of the ideas just expressed, and has been mainly of a general nature. I have made a series of accurately measured sections across the State in such directions as seemed to exhibit most clearly its general Geology.

Sec. No. 1. Extends from Racine along the line of the Racine & Miss. R. R. to Rock River, at Beloit, thence westward along the line of the Southern Wisconsin R. R. to the Mississippi River, opposite Dubuque.

Sec. No. 2. From Milwaukee west along the line of the Mil. & Miss. R. R. to Rock River, at Janesville.

Sec. No. 3. From Milwaukee along the line of the Watertown R. R., through Madison and the Blue Mds., to the Miss. river.

Sec. No. 4, From Madison down the Black Earth and Wis. River vallies to the Miss. River.

Sec. No. 5. From Milwaukee northwest along the line of the La Crosse R. R. to Portage City, thence westward to La Crosse.

Sec. No. 6. From Sheboygan west, through Fond du Lac, Ripon and Green Lake to Princeton, Marquette Co., on the Fox River.

Sec. No. 7. From Manitowoc westward to the Fox River at Appleton, thence to Wolf River at New London, and thence to the Wisconsin River, at Stevens Point.

Sec. No. 8. From Beloit through Madison to Portage City.

Sec. No. 9. From Beloit north through Watertown, Fond du Lac, Oshkosh, Appleton and Lake Shawano, along the line of the Chicago, St. Paul, Fond du Lac and Lake Superior R. R., to the State line north.

Sec. No. 10. From Kewaunee on Lake Michigan, westward to Green Bay City, thence to Lake Shawano and Wolf River.

These sections generally run across the dip of the strata and exhibit the outcrops and relations of the various rocks exposed along the lines which they traverse. They are generally made on lines of surveyed Railroads, or along the valleys of the principal streams, as it was only by following these that we could get any reliable standard of reference for heights and distances. These standards are of great value with us as we have no topographical survey in conjunction with our geological survey, and when reliefs are so uniform as ours, very little can be done with the barometer without bestowing more attention upon it than we could well afford.

As soon as these sections can be properly executed on paper they will be safely deposited and kept, so that in case of accident they will not be lost to the State. The failure of some Geologists to put their work into such shape as to be understood by others, has been a cause of great loss where death or other circumstances have terminated their connection with a survey.

In addition to these sections I have examined the district between the Wolf and Fox rivers and along the shores of Green Bay as far as the Oconto, also the country lying between the Wisconsin river and the Mississippi as far North as Black River Falls.

In order to forward as rapidly as possible the ecomical results of the survey, I have made special visits to such points as seemed likely to yield anything of value. These general explorations have determined many points of interest.

I have collected and forwarded to Madison over 2,000 specimens of ores, rocks, fossils, etc., during the season. For their temporary accommodation I have fitted up a room in one of the buildings of the State University where the specimens may be stored, examined and classified preparatory to being permanently arranged in the State collection. These specimens will be a valuable addition to the cabinet, and can be seen by yourself or the Legislature at the University.

The great importance of the Iron interest of our State has induced me to make it an object of special attention. Accordingly I have examined with great care every locality which promised any considerable yield of valuable iron ore, and in a few cases where important interests were involved in the quality of the ore I have submitted specimens to the distinguished chemist Dr. Charles Jackson, of Boston, for analysis. The results and all questions connected with the manufacture of iron in our State I have considered in a paper herewith appended, "On the Iron Ores of Wisconsin," to which I beg leave to call your attention.

In concluding this notice of my season's labor, it is proper to state that I have had no permanent assistant, the condition of the fund not allowing me to employ one, I have however employed such help as I could not do without at my own expense.

I wish here also to express my thanks to the citizens of those portions of the State where my work has led me for many acts of courtesy and co-operation. I am under great obligations also to S. F. Johnson, Chief Engineer, Chicago, F. & St. P. R. R.; Robt. L. Harris, Esq., of the Racine and M. R. R.; E. W. Woodward, Esq., of the LaCrosse R. R.; Jasper Vliet, Esq., of the Berlin & Horicon R. R., for the use of profiles and much valuable information and facilities for carrying forward the survey along their respective roads.

Respectfully submitted,
EDWARD DANIELS.

Iron Ores of Wisconsin.

No metallic ores are so abundantly distributed as those of iron. They enter more or less largely into all the great mineral masses of our globe, so that it would be scarcely possible to find a fragment of rock or a handful of soil entirely destitute of iron in some one of its varied forms. In our own State these ores are unusually abundant. They occur in connection with rocks of various geological age from the primary slates to the lower members of the upper silurian formation. They are found generally in one of the following modes of occurrence:

1st. In place as beds or veins in the rocks where they were originally formed or introduced.

2d. Deposited from aqueous solutions in low ground, as bog ore or ochre.

3d. Scattered over the surface or mingled with the soil and superficial deposits in fragments or minute particles.

The valuable deposits of ore belong mainly to the first and second class. Instances of the last are however much more common, and though worthless, often excite large expectations. They are especially abundant in the sandy regions of the State, where fragments of ore are found on every hillside, and the soil is everywhere stained with iron. The coloring matter of the sandstone itself is generally derived from ores of this metal disseminated through it, whose decomposition originates the chalybeate springs which so frequently rise in the valleys along its outcrop.

Fragments of magnetic, specular and micaceous iron ore are very abundant in the drift of the central part of the State, also patches of sand, generally on the lake shore, containing minute grains of magnetic ore. These are found in connection with boulders of igneous rocks and fragments of native copper and have undoubtedly a common origin.

We have the most conclusive evidence that they were derived from the north, some of them as far even as Lake Superior, where we know similar ores and rocks exist, in place. To explain their transportation to the distant localities where we find them so abundantly, we have only to refer to the action of causes now producing similar results. On the ocean, ice-bergs are often seen by navigators floating southward far into the Temperate Zone, borne along by submarine currents, and carrying with them rocks, gravel and other materials derived from the colder regions where they were formed. As they gradually melt under the warmth of milder latitudes, their lading is slowly distributed along the path of the great current which moves them on, and thus the bed of the ocean is being strewed with the ruins of northern lands.

At a period of high absolute antiquity, but comparatively recent in the geoloeical chronology, the greater portion of our State was covered by the sea.

Far to the northward were elevated lands around which ice-bergs were formed, freezing into their mass the rocks and soils upon which they rested. Great fields of ice also stretched away from the base of hills and mountains from whose sides the avalanche came thundering down, loading the ice with rocks, ores and the loose material of the surface. When summer came, the ice, released from the shores where it was formed, and moved by currents setting southward, bore away its burden and dropped it from place to place as it slowly melted away.

There is reason to believe that sudden elevations of great masses of land in distant portions of the globe also occurred during this period, causing immense waves to rush with tremendous force over the submerged lands, and transporting the rubbish of the ocean bottom from place to place. Thus we can explain the distribution of those scattered primary iron ores, and pieces of native silver and copper, in company with boulders of igneous rock, from Lake Superior, south across Wisconsin, as far as Springfield, Illinois.

We know that these and other ores occur abundantly in the region around Lake Superior, and we have only to recur to the changes through which our globe has passed, to account for their transportation hither. The ice-bergs of an ancient ocean were the first explorers of our northern mines.

They, tore open the stony treasuries of nature with their giant arms, and seizing upon the glittering ore bore it away only to scatter it in their sport over the ocean floor.

The ocean has returned to its limits, and we now find our home on the very spot where its waves once rolled. The wandering red man picks up these scattered metals and treasures them as charms and fetishes, or fashions them into arrows and hatchets, and his civilized brother, the white man, founds upon their discovery extravagant visions of wealth.

From this explanation, (which I have made because it is a subject of very frequent inquiry,) it will be seen at once that no valuable expectations can be safely based upon the discovery of these isolated fragments of ore. Where, however, pieces of ore are found very abundantly, and especially where they are not accompanied by boulders or drift gravel, they may be the float of some deposit not far away, and justify a careful examination.

The deposits of bog ore are very numerous in the swamps and marshes of the State, but I have found none as yet of sufficient extent or richness to be of value. It is quite important that these ores should be discovered here in quantity, as they are valuable to mix with the harder and richer ores.

They generally occur near the edges of marshes, and may be easily recognized by the appearance of ochre or iron rust which they present. Their extent may be readily ascertained by sinking a few test pits over the low grounds to a sufficient depth.

I shall proceed now to speak of those deposits of ore which are likely to become valuable as a basis for the manufacture of iron in our State.

ORES OF THE IRON RIDGE—DODGE COUNTY.

The principal part of this ore is located on sections 12 and 13, in the town of Hubbard. It occurs in the form of a bed, interposed between a massive grey limestone above and a soft blue shale below.

It makes a presentation at the surface along the outcrop of these rocks for more than a mile, and dips conformably with them eastward. Its greatest thickness is at the eastern end of the bed, where the limestone has been removed and the whole mass has crumbled down so as to be shoveled up like dirt. It is here about 25 or 30 feet thick, but where it lies in place under the limestone, it ranges from 10 to 15 feet, thinning towards the east.

The underlying shale has been pierced 20 feet in sinking a well, and a hard blue limestone filled with fossils encountered at that depth.

The geological position of this ore is probably very correctly stated by Col. Whittlesey, who visited it while connected with the U. S. Geological Survey.

He refers it to rocks of the same age as the Clinton group of New York. The base of the ridge along which the sandstone, the ore, and the upper part of the shale present themselves, is covered deeply with drift, and no rocks are seen upon the surface for several miles in any direction.

North and west about 8 miles, the Trenton limestone is found, capped by 15 feet of Galena limestone. These rocks dip eastward and a careful examination of the ground proves clearly that the upper surface of the Galena limestone cannot be more than 40 or 50 feet below the ore bed at Iron Ridge. This fact serves to point at once to the equivalency of the blue shale with that which overlies the Galena limestone in the lead region of the State.

I discovered that shale first in 1851, and afterward noticed it in my first annual report upon the geology of Wisconsin in 1853, under the designation of "Nucula Shale." It seemed to have been previously overlooked by the geologists who had visited the mines on account of its very general removal by erosion. Notwithstanding its great importance as one of our formations, (attaining as it does a thickness of 60 feet,) when its soft and perishable nature is considered, it does not seem strange that it was not observed before. It forms the base of the large conical "mounds" or hills of the mining region, and its position can readily be ascertained by the springs, which mark it everywhere. Its lower portions there are highly fossiliferous, and contain pyrites and occasional seams of beautiful crystalized gypsum. It is very finely exhibited in the great cut at Scales Mound on the Illinois Central R. R., just south of the State line. It is not seen east of Blue Mound until we encounter it at Iron Ridge.

In the west it is capped by about 400 feet of limestone which form the upper strata of the "mounds." These limestones contain abundant fossils, and were first properly located by Prof. Hall in the upper silurian, the equivalents of the Clinton and Niagara groups of New York. They are evidently identical with the limestones which form the upper portion of Iron Ridge, and which extend thence uninterruptedly south as far as Joliet, Illinois, and north nearly as far around the shores of Lake Michigan.

The shales are also identical, and have been recognized by Prof. Hall in Foster and Whitney's Report on Lake Superior and district, as belonging to the Hudson River group. The geological position of this ore and its accompanying rocks may therefore be considered as settled. The limestone above the ore is a coarse cavernous sub-crystalline rock, in layers from 4 inches to a foot thick. It is intersected by very large open fissures, which extend back some distance from the ledge, and can be seen ramifying in all directions on the thinly covered surface.

I observed similar fissures in the same formation, on the east shore of Green Bay, above the Bay Settlement. This rock at Iron Ridge contains but few fossils, and those mostly casts. It is a magnesian carbonate of lime, quite pure.

The physical character of the Iron Ridge ore is different from that of any other deposit known in this country. It is apparently related to the oolitic ores, though it differs from any of them that I have seen described. It consists of small grains or concretions, varying in size from a mustard seed to four times as large, quite irregular in shape, but usually slightly oval and flattened to a disc. Color bright red, with a glistening polished surface, which feels greasy to the touch and stains like red chalk.

These grains are apparently concretions formed around minute particles of silica, as is shown in Dr. Jackson's analysis. Their flattened form seems due to gravitation. The deposit is unquestionably of aqueous origin, but I have as yet found no fossils in it nor do I know of any being found by others.

When found in place, the grains are cemented together into a moderately firm mass, which is regularly stratified like the limestone above, and intersected by joints and cleavage planes. The grains lie flatwise parallel with the bedding, and are occasionally mingled with nodules of very compact hematite, which seems to have been formed by chemical changes, induced since the original deposition of the ore. These are of various forms and sizes and have the color and glistening surfaces of the small grains.

Where the limestone has been removed, the cohesion of the particles is soon destroyed by atmospheric agencies and all traces of stratification disappears. A large quantity of ore has been thus partially decomposed, and in some instances washed down the hill side and formed a subordinate deposit. In some cases it has mingled with clay, and forms an excellent red chalk and mineral paint.

This loose ore is known as "seed ore" among the furnace men who work it.

The limestone in contact with the ore bed is often filled with cavities containing crystals of specular ore and pyrites, and much iron is diffused through the whole mass.

The amount of ore existing in this bed cannot of course be calculated with precision, It is safe, however, to estimate a continuous layer of 10 feet over 500 acres of ground, which would give us 27,225,000 tons of available ore, capable of yielding 13,612,500 tons of metalic iron. This bed of ore would, therefore, supply one furnace, producing 10 tons of iron per day, for 37,394 years, or ten furnaces of the same capacity for 3,739 years. It may therefore be regarded as inexhaustible.

The chemical composition of the Iron Ridge ore is a matter of great importance, and as several analyses had previously been made which differed considerably on points of practical moment to the iron interest, I thought best to have a new examinotion. I therefore submitted this ore to Dr. Charles Jackson, of Boston, whose distinguished reputation both in this country and Europe, invests his results with authority wherever they may be read, and whose large experience in the examination of iron ores, especially qualified him for the task.

The specimens selected were from the ore as it was prepared for the furnace, and where all the qualities of that kind of ore would be likely to present, and Dr. Jackson was requested to spare neither pains nor expense in ascertaining the existence of any substances which would injure the quality of the iron made from it.

The results here given in his report upon specimen No. 3, apply to the great mass of loose ore at the western extremity of the outcrop where the Northwestern Iron Co. obtain their ore.

STATE ASSAYER'S OFFICE,
32, Somerset st., Boston, Dec. 17, 1857.

PROF. E. DANIELS,
State Geologist to Wisconsin,

DEAR SIR:—I have analyzed sample No. 3. of the iron ores you left with me, and have obtained the following result.

It is an oolitic iron consisting of flattened grains, the spheroids having grains of quartz sand as nuclei. These grains are cemented together by a clayey like mass of fine ore.

On chemical analysis, made with the utmost care, the following results were obtained per cent.:

Water, ...	8,750
Silica, ...	7,750
Magnesia, ...	0,640
Alumina, ...	8,400
Oxide of Manganese, . .	1,400
Lime, ...	0,560
Peroxide of iron, . .	72,500—50.77 metallic iron.
	100,000

This ore was searched for phosphoric acid, sulphur and sulphuric acid, arsenic and arsenious acid, but no trace of them can be discovered. The magnesia and the lime are combined, not with carbonic acid, but with silicic acid or silica. The alumina is combined with silex, forming with the above named silicates a clay, which is mixed with the iron ore. Oxide of manganese, in the proportions in this ore, is beneficial to the iron, and improves the quality of bar iron made from it, giving it a good steel forming quality.

Properly smelted, this ore will make good pig and bar iron

Yours, Charles T. Jackson,
State Assayer.

It will be seen by this analysis that Dr. Jackson failed to find phosphorus in this ore, though careful search was made for it. The ore has long been reported to contain that noxious substance, which was supposed to cause the brittleness seen in castings made from it, when cold.

It is the opinion of Dr. Jackson that this brittleness is caused by the silex which forms the nucleus of the grains of ore, and which, from its intricate combination, is not separated by the ordinary process of reduction. He recommends a mixture of calcareous ores, or a flux of lime, with careful experiments as to amount of materials. This peculiarity does not injure the ore for bar iron or steel, and its composition is eminently favorable for those purposes.

The location of this bed of ore is such as to make it the basis of an extensive manufacture of iron. It is encircled in all directions by heavy hardwood timber, most of which will be tributary to the furnaces, furnishing charcoal cheaply and abundantly for a long time to come.

It is but 40 miles from Lake Michigan, with which it is connected by the Milwaukee & La Crosse R. R. This road runs directly through the ore bed, and furnishes means of transportation for the iron east or west, connecting with other lines at its termini and along its course. When the present stock of fuel shall be exhausted, coke from the coal beds of Illinois can be brought to the ore, or the ore carried to the coal at a trifling expense above the present cost of charcoal.

All the materials that are required for fluxes, lime, sand and clay, are found in great abundance near the ore bed.

The expense of mining the ore is trifling, not exceeding 12 1-2 cents per ton. It requires no roasting, and yields its iron by the simple application of heat in its original state.

The Northwestern Iron Company have a blast furnace in operation at Mayville, 4 1-2 miles from the ore bed. This locality was selected on account of the water power, which they use in driving their blast and other machinery.

They make a ton of pig iron from two and a quarter tons of ore, allowing for all waste in manufacture. They have also an extensive foundry just completed, where they are making water and gas pipe, lamp posts, building fronts, and heavy castings generally, at prices which defy all competition. They are able now to supply the home market with castings of the best quality made directly from the ore.

The product of their last blast was 3528 tons of pig iron. They are preparing to erect extensive works at the ore bed as soon as the demand for iron shall justify it.

There can be no reasonable doubt of the feasibility of manufacturing profitably, iron, nails and steel whenever capital enough can be turned in this direction to sustain the extensive works required for such a purpose.

The experiments thus far made, amount to nothing in determining the full value and capacity of this ore, and we are fully justified in placing it, when all its circumstances are con. ered, at the head of the iron deposits of the Northwest.

In consequence of the failure of the first experiments at Iron Ridge, this ore fell into disrepute, and is even now supposed to be worthless by many who are not familiar with the recent successful results. It should be remembered, however, that nearly all mines of iron and coal, are at first regarded as valueless. Every ore bed presents some new feature, and requires often patient and long-continued experiment to ascertain its true value, and the best mode of rendering it available. It is rare also to find an ore which is valuable for many uses, unless combined with other ores.

Even the best Scotch pig is improved by a mixture with this iron. We may be quite certain, therefore, that as experiments shall be made with our ores, either by new combinations or modes of working, latent properties and values now unknown will be developed.

The accompanying certificates from several of the principal iron manufacturers of the west, are the best possible attestations to the value of this deposit of ore. The Northwestern Company deserves great credit for the quiet, persevering manner in which it has proceeded in the development of this great interest. It is now realizing rich returns upon its heavy investments, and promises to be a most profitable concern to its stock holders.

CHICAGO, June 11, 1857.

To the Northwestern Iron Company, Dodge Co., Wisconsin:

GENTS:—I have used in my foundry here, and been acquainted with your pig iron, made in Wisconsin, nearly four years; and can say from its peculiar solidity, and the smoothness with which it runs, that no better pig iron can be procured here for gas, steam or water pipes, lamp posts, etc. For machinery, I find by mixing with stronger irons, it improves the smoothness of the castings, and by its always running solid, prevents the loss of castings, which might occur with more *open* or *porous* irons.

Yours respectfully,

FRANK LETZ.

CHICAGO, June 11, 1857.

To the Northwestern Iron Company:

GENTS:—We have used your iron made in Wisconsin, and can say that from the smoothness of the castings, and its solidity, we consider it a superior pig iron for the manufacture of all kinds of water, gas and steam pipe.

For machinery purposes it requires an admixture of stronger iron, giving the stronger iron solidity and smoothness of surface.

Respectfully yours,

STONE, BOOMER & BOUTON.

MILWAUKEE, June 12, 1857.

To the Northwestern Iron Company:

GENTS:—We have used your pig iron in our foundry in this city for nearly four years, and from our knowledge of its peculiar qualities, can recommend it as being a very durable and superior iron for building purposes, water, gas and steam pipes, lamp posts, etc..

For machinery it requires an admixture of stronger iron, or scrap, but on account of its solidity, and the smoothness with which it runs, it improves the quality of stronger and even higher priced iron.

DECKER & SEVILLE.

MILWAUKEE, June 9, 1857.

To the Northwestern Iron Company:

GENTS:—We have used your pig iron some four years, and from the smoothness of the castings made from it, and its *solidity*, which is peculiar to your iron, we consider it the best article that comes to this market for house building purposes, and more especially for gas, water and steam pipes.

For machinery purposes, when mixed with stronger iron, it gives solidity and smoothness, and improves the same, although too weak to use alone for this purpose.

A. J. LANGWORTHY.

OSHKOSH, June 8, 1857.

This is to certify that, we have used the pig iron manufactured by the N. W. Iron Co., for three years, and by mixing 1-3 H. R. iron, 1-3 Scotch and 1-3 Wisconsin, it makes an excellent machinery iron. But for building purposes, or for gas, steam and water pipe, the Wisconsin iron manufactured by the N. W. Iron Co., used without any admixture of other irons, cannot be excelled by any iron that comes to this market.

POWERS, ROGERS & CO.

Fond du Lac, June 8, 1857.

To the Northwestern Iron Co., Dodge Co., Wis.:

Gents:—We have been using your iron for four years, and find by mixing 1-3 Rossee, and 1-3 strong scrap iron, it makes excellent machinery. No better mixture of iron can be procured in this market.

On account of its solidity and the smoothness of its surface, it is the best quality we know of for building, castings, and especially for gas, water and steam pipe, requiring no admixture with other irons for those last purposes.

Wilber, Peacock & Co.

I have just received the following letter from the Hon. Byron Kilbourn, Superintendent of the Milwaukee & La Crosse R. R. The analyses made by Dr. Chilton agree in the main with those of Dr. Jackson, but they are less complete

ANALYSIS BY DR. JAS. R. CHILTON.

1st, Hard or Natural Ore—Iron Ridge.

Peroxide of iron, . . .	77.40—iron 54.18
Silica, ...	9.11
Alumina, ...	2.26
Lime, ...	6.72
Magnesia, ...	0.41
Water—with loss, . . .	4.10
	——100

2d, Seed Ore—Or Disintegrated Ore.

Peroxide of iron, ...	79.25—iron 55.47.
Silica, ...	6.18
Alumina, ...	2.49
Lime, ...	6.81
Magnesia, ...	0,14
Water—with loss, . . .	5.13
	——100

Milwaukee, January 6, '58

E. Daniels, Esq., State Geologist,

Dear Sir:—Yours of 2d inst. has been duly received. Above I hand you the result of analysis by Chilton, in which you find neither sulphur, phosphorus nor Manganese. The two first I requested him particularly to look for.

I had several experiments made by puddling, and uniformly with excellent results. Whatever substance it is that produces cold shortness in the pig or cast iron, seems to be expelled by the process of puddling, as in every instance we have obtained a first class of wrought iron, without any intermixture of other ores. For railroad iron it is of the first class, and can be produced cheaper at that locality, as I believe, than at any other place in the U. S. This is in consequence of the great ease with which the ore is procured, being at a nearly nominal cost, and the vicinity of a finely settled and productive agricultural region, in which supplies of every kind are to be procured with facility.

I will send you a piece of the bar iron made from the Mayville pig at Fall's village, Salsbury Co., by the first opportunity that offers.

Yours very truly,
Byron Kilbourn.

IRON ORE OF HARTFORD, WASHINGTON CO., AND OF DEPERE, BROWN CO.

At Hartford, 14 miles south-east of Iron Ridge, a bed of ore occurs, having the same physical character and geological position as that just described.

The country between these two points is covered with drift and it is impossible to ascertain whether this is a distinct deposit, or connected with that at the former place. It is probably a distinct bed, as the Iron Ridge ore thins rapidly eastward. This bed attains a thickness of 6 or 7 feet, and is found near the surface in the valley of the stream. It has been struck in digging wells, which have been sunk into it on the town plat, where it occurs at a depth of from 15 to 20 feet from the surface. The bed is not as thick here as at Iron Ridge, and has a less horizontal extent. It is generally covered by the limestone, and very rarely decomposed. Its chemical composition is undoubtedly very similar to that of Iron Ridge.

The same ore is found again 80 miles N. N-E. of Iron Ridge, in the town of Depere, about 4 miles east of the village, and about 7 miles south-east of Green Bay. It occurs on the western face of the ledge, which extends along the Fox River and Green Bay, nearly parallel with their vallies.

This ledge is formed by the outcropping edges of the Clinton and Niagara limestones,and at its base, generally concealed beneath the rubbish, the shales of the Hudson River group are fonnd.

At this point a spring brook pours its waters, forming a cascade whose rare beauty rivals even the famed Falls of Minnehaha. The falling water has excavated the underlying rocks, and exposed a clean section, including the upper portions of the shale so generally concealed, and revealing between it and the limestone a bed of lenticular ore 6 1-2 feet in thickness. It presents an occasional outcrop as we trace it along the base of the escarpment for about 200 rods, and is not seen again, as the slope is deeply covered.

It is identical in age, composition and structure with the Iron Ridge and Hartford ores, but the shale seems to be more mixed with the ore than at those places.

Its position in respect to water transportation is very favorable, and as the whole region is covered with forests of hard timber as yet scarcely touched by the woodman's axe, fuel can be easily supplied. It is only 4 miles from a steamboat landing, and its products can be cheaply transported to any western market. The land on which it occurs is mainly owned by Hon. James Howe, of Green Bay, and D. M. Loy, Esq., Depere.

Traces of the same ore are also seen along the ledge northeast of Green Bay, but no considerable deposit occurs.

IRON ORES OF BLACK RIVER FALLS.

The ores of this region have hitherto remained almost entirely unnoticed, although their great value justified a much earlier exploration.

They were first discovered by Mr. Spaulding, one of the proprietors of the town, while connected with the Government surveys. They are mentioned by Dr. Shumard, the accomplished palaeontologist, of the Missouri Geological Survey, in Owen's report of 1851.

The Geology of this portion ot the Black River Valley presents many points of interest both scientific and economical. The Potsdam sandstone is the prevailing rock, giving origin to the sandy soil which covers the surface everywhere except on the hillsides or in the lowest valleys, where patches of clayey soil occur. The surface is generally level or gently rolling, but occasionally the outliers of the sandstone rise in castellated cliffs and towers of great beauty. These are usually the culminating points of the relief and from their tops magnificent views of the surrounding country can be obtained. At a lower level rounded hills are seen composed of the softer beds of sandstone, or of the primary slates which underlie them.

The Potsdam sandstone contains fewer calcareous bands here than farther east, and is generally soft and crumbling. The configuration ot the country is due to the erosion of the sandstone, which once stretched across the broad valleys, as high as the loftiest outliers which now remain to mark the ancient limits of this formation.

Occasional fossiliferous beds occur, one at the base of the sandstone, filled with dim casts of large crustaceans, others at higher levels with lingula prima and lingula antiqua, often so abundant as to compose half the bulk of the layers in which they are found. The decomposition of these shells has had a very important influence upon the soil, redeeming it in great measure from the sterility which is so common where sand predominates. Immediately beneath the sandstone and occasionally rising through it in rounded hills from 100 to 200 feet high we find the azoic and igneous rocks. The former consist of chloritic, micaceous and argillaceous slates; the latter of granite, trap and sienite.

The sandstone gives no evidence of disturbance or metamorphism by heat, but reposes upon the upturned edges of the slates or rounded summits of igneous rocks, with only such slight dips as would naturally result from deposition on an uneven surface. In its lower beds near the line of junction it often contains waterworn fragments of these rocks mixed with pebbles of quartz. The slates and igneous rocks are seen only at comparatively low levels where they have been uncovered by the removal of the sandstone. The igneous rocks are entirely confined to the banks and bed of the river. Very fine sections of the junction of these rocks with the overlying sandstone are exhibited along the river.

The iron ore is associated with the chloritic and micaceous slates of the azoic rocks. It occurs in the isolated ridges or mounds formed by these rocks, and is encountered occasionally over the space of a township. The most important deposit however is located on sections 10 and 11, township 21 north, range 4 west, about two miles above the village of Black River Falls. In descending the river we first meet with this ore, about 50 rods below the mouth of Allen's creek, on the west bank. The slates here rise from the waters edge and present a clean exposure of about 18 feet dipping S. W. 45°. They are very soft and fissile and exhibit a curved lamination. The upper portion of the slope is concealed by debris but the surface is covered with fragments of ore and white quartz and a brecciated conglomerate of sand, ore and slate. Sixty feet above the water the sandstone is seen forming the top of the bluff. This exposure extends about 15 rods and is then covered for a short distance but soon emerges again and rises in a bold cliff 60 feet above the river. It contains here bands of hard massive hematitic ore, from 6 to 40 feet wide. The slates are divided by smooth joints into large angular blocks, and the same joints pass uninterruptedly through the ore, which partakes also of the slaty cleavage. It has often a ligniform structure, occasionally so distinct as to resemble perfectly pieces of fossil wood. Quartz is sometimes found combined with it in alternate layers, giving it a banded appearance. It is usually massive, having a sub-conchoidal fracture, dark grey color tinged with red, sub-metallic lustre, and sometimes magnetic. Veins of red ochre resulting from decomposition are common. From this point the slates and ore sink rapidly towards the south-east, and 40 rods below just emerge from the water. Here they seem to cross the river as they occur on the opposite side, presenting nearly the appearance before described.

The ore has been mined here in the edge of a low bluff on the N. E. qr. of the S. W. qr. of sec. 11, about 60 feet above the river. It is here a mixture of red and brown hematite with numerous nests and seams of ochre, often banded and uniform and at its junction with the slates very siliceous.

It is bounded on the north by very fissile chlorite slate which seems to shade off gradually into the ore. The opening made in the bank displays the connection of the slate and ore very clearly. They both dip conformably 55°, in a direction nearly E. S. E., and are intersected by joints and cleavage planes similar to those on the other side of the river. The surface is covered with ore for about 40 rods south of this opening but no clean exposure occurs.

After passing over a space of a few rods covered with drift, and destitute of ore, we strike a heavy deposit of black oxide highly magnetic. This deposit rises southward and has been quarried for the furnace, so as to present a clean exposure 45 feet high fronting the river, showing a dip of 75° S. E. No rock is seen in connection with the ore here, but it has the general dip of the slates which have no doubt decayed and left it alone. It is mixed with veins and nests of quartz, which separate from it by burning. By this last process it seems to lose its magnetism also.

From this point the ground rises rapidly about 40 rods south, till it culminates in a large hill known as Tilden's Mound, 180 feet above the river. The base of this hill is occupied by chlorite slate, but the upper portions are covered with ore. South of this place no slate or ore is seen but about 12 rods from the base of Tilden's Mound S. W., in the bed of the river occurs a low mound of greenstone trap rising 5 feet above the water, and a few rods farther west are two small islands of the same rock, which are seen in the accompanying section. It is a very heavy, fine grained greenstone, highly ferruginous, and divided by joints into angular blocks and tabular masses. Its proximity to the ore may perhaps have some connection with the magnetic condition, which this portion of the deposit has assumed. West of these trap islands about 15 rods, a light colored reddish sienite, composed of red feldspar and green hornblende, rises 12 feet above the water and forms the lower portion of the river bank. This rock extends with occasional interruptions 3 miles below, sometimes rising 50 or 60 feet above, and again sinking beneath the water. At the falls it extends across the river and forms a natural dam, to which is due the splendid water-power which constitutes the principal interest of the town. At the Falls it is intersected by veins of quartz, in which are occasionally found minute particles of sulphuret of copper.

Small veins of specular iron ore are seen also, often traceable for 20 or 30 rods, accompanied by light colored quartz. the sienite is last seen near Ledyard's mills where a soft, decomposing gneiss or stratiform granite rises 12 feet above the river.

The texture and hardness of this rock are very irregular. It contains seams of quartz which are left by the decomposition of the feldspar and mica, and also scattered specs of copper pyrites. Its dip is about 65°. The lines of stratification are curved near the edges as if bent down by some great weight resting upon them.

Above this rock, and resting almost horizontally upon its upturned edges, is the Potsdam sandstone. The lower layer is a band of conglomerate with micaceous sandstone, succeeded by a thin seam of micaceous shale, and this again by coarse sandstone, which rises to the top of the bank.

The upper portion of the gniess has often decomposed, and in some instances its constituent elements have been recomposed, and have formed a rock beneath the pressure of the sandstone, more enduring than that from which it originated. The product of this chemical change seems to be a sort of consolidated kaolin containing mica, and perhaps chlorite, which it resembles in softness and greasy feel. It cuts readily with a knife, and when polished and wet, presents a beautiful mottled surface, caused by a light colored mineral like feldspar, semi-crystalized upon a ground of green and gray.

Some fine blocks have been cut from it, but the rock is probably too limited and fragmentary to be of any commercial value.

This gneiss continues above the river for about a mile below Ledyard's, where it passes beneath the sandstone a short distance above Shepherd's mill. At this mill a small island of sandstone occurs, composed of the coarse grits which lie just above the granite. The upper layers are filled with casts of very large trilobites, and on a smooth surface of the sandstone, beneath a seam of shale, the tracks of these animals are seen marked by two rows of double impressions parallel with each other. The position of these remains and tracks cannot be far from the base of the lower Silurian, still it is quite possible that the igneous and azoic rocks on which these sandstones rest were hills in the ocean of the Potsdam period, and that older beds have been deposited in its valleys. I have made this extended notice of the geological association of the Black River ores on account of their peculiar and unusual interest.

The accompanying section from the iron works through the ore at Tilden's Mound, and across Black River, will exhibit clearly, its connection with the rocks.

The following analysis by Dr. Jackson, made with great care indicates the quality of these ores:

1st. Red Oxide of Iron in ligniform masses.

Water, ...	1.50
Silica, ...	26.75
Oxide of Manganese, . .	3.65
Peroxide of iron, . .	67.50—47.27 metallic iron.
Loss, ...	60
	100.00

2d, Specular and Magnetic Iron ore.

This specimen was analyzed only for iron. It yielded:

Silex, ...	36
Peroxide of iron, ...	64

"It therefore contains 44.82 per cent. of metallic iron. It is a good ore to smelt with calciferous ores, or with rich hemetites. Alone it will require a large proportion of lime for a flux.

Oxide of manganese in the proportion found in these ores is beneficial, and improves the quality of bar iron made from them. Properly smelted, these ores will make good pig and bar iron."

These ores are very accessible and can be cheaply mined. They are located within 4 miles of flatboat navigation to the Mississippi, and on the line of the Land Grant Branch of the La Crosse Railroad.

Though the region around is mainly occupied by pine timber, bands of hard wood occur which will furnish a considerable supply of charcoal. It will not, however, be sufficient for an extensive and permanent manufacture, as iron cannot be made profitably with pine charcoal in this country. Some other supply of fuel must be sought for permanent uses, and the cheapest and most reliable will no doubt be found in the coal seams of northern Illinois, with which it would be well to secure an early connection. This can readily be done through the Mississippi River to Dubuque, and thence by the Illinois Central Railroad, and thus an inexhaustible supply of fuel secured, with an outlay very much less than required by the purchase of timbered lands, or the transportation of charcoal.

An enterprising German Company have recently erected a blast furnace, driven by water, on the east bank of the river. They mix the red oxide and magnetic ores, and flux with lime.

They have attempted to use hearths from the Potsdam sandstone of the neighborhood, but have failed to make them work, on account of the lime which they contain.

They have also burnt out a hearth from Amherst, Ohio. In consequence of these failures they have not yet made much iron, but the results are so far highly satisfactory.

From their experiments the following facts are ascertained: Two tons of the ore will yield one ton of pig iron; cost of mining, $1,50 per ton, including delivery at furnace; twenty per cent. of lime required to flux the ore.

An approximate estimate of the amount of ore at this point will be entirely safe at the following figures:

West bank of the river, on land owned by Darrow and Curts, 15,000,000 tons; east bank of the river, 28,000,000 tons, including the Iron Company's location and Tilden's Mound, giving an aggregate of 43,000,000 tons of available ore.

Other deposits exist in the vicinity, which will no doubt be valuable in time, but which are less favorably located for present working.

This locality is well worth the attention of iron masters and capitalists, on account of the accessibility and superior quality of its ores.

It is also a good agricultural region, and lands may be obtained very cheaply for farming purposes. The soil, though less durable than in some localities, is warm, quick and easily worked, and the adjacent pineries furnish an excellent market for the products of the farm.

BROWN HEMATITE OF IRONTON, SAUK COUNTY.

This ore is located in the town of Marston, on sections 9 and 10, town 13, range 2, east. Its geological position is in the Potsdam sandstone, which occupies most of the surrounding country, capped on the highest points by limestone, (lower magnesian limestone.)

The ore presents itself on the east bank of Tower's creek, and extends from the brow of the hill down its slope, and some little distance into the valley. The surface is covered with fragments over about ten acres, generally small, but sometimes attaining a ton's weight.

Several shafts have been sunk through the ore on the hillside to the depth of 10 to 20 feet. It was found extending to that depth, mixed with fragments of sandstone and flints, but no rock in place has been found yet in excavating. Large masses of sandstone lie upon the surface, in the fissures and cavities of which veins of fibrous hematite occur; also fragments of very pure white hornstone similarly mineralized.

No clean section can be obtained here, as the entire slope is covered with loose material. It is therefore impossible to state the precise form or extent of this body of ore. On the surface it extends about 60 rods east and west, and 30 rods in width.

The valley of Tower's creek in which it occurs has been worn out of the sandstone, which rises on either side over 300 feet, and is capped by limestone on the west.

The ore was no doubt formed in the sandstone previous to the wearing down of the valley, and by the removal of the rock in which it was once contained, has been left scattered upon the surface, or mingled with its rubbish.

No marks of volcanic action are seen in the vicinity. The strata of the sandstone are undisturbed, generally soft and crumbling, but furnishing some layers hard enough for good building material.

Some very fossiliferous bands occur, filled mainly with trilobites, rarely however well preserved.

The specimens collected for analyses were not forwarded to me in time, and I cannot therefore present in this report the composition of the ore.

It is, however, clearly a hydrated brown oxide, quite pure, generally massive, but frequently stalactite and mamillary, often assuming beautiful imitative forms. In the seams it is fibrous, and sometimes banded. It occasionally contains small pebbles of quartz, intimately mixed with the ore like a conglomerate.

It will yield 45 per cent of metallic iron. It is safe to estimate its amount as equal to a solid bed 5 feet thick over 10 acres, which would give us 272,500 tons of ore.

The country around is heavily timbered, and lime and other material needed in a furnace convenient.

Jonas Tower, Esq., an ironmaster of large experience and great practical skill, has erected a small blast furnace, capable of producing about 3 tons of iron per day, and intends to manufacture stoves, castings, etc., on the spot. The amount of ore is of course too small for an extensive or permanent business, but will do well to supply the local demand.

I observed a similar ore in the same geological position, in the tunnel west of Tomah, on the La Crosse Railroad. The top of the hill above the tunnel is covered with fragments, which occur also occasionally in the dirt thrown out of the excavation. Large fragments of white hornstone, intersected by small seams filled with black hematite, are common from Garrisonville, on the Baraboo, westward and northward as far as Black River. They are also frequently met with, east of the Wisconsin as far as Lake Mills, Jefferson county.

SPECULAR AND TITANIFEROUS IRON OF BARABOO.

The lower part of the Baraboo valley is one of the most interesting portions of the State. In variety and picturesque beauty of scenery, it cannot be surpassed in the west. The Potsdam sandstone has here been violently disturbed, and in some cases changed, from a soft crumbling state into a very hard quartzite, usually of a red color, but often grey or banded with red and white. Ranges of this quartzite extend often several miles, and form lofty hills with preciptious escarpments. The high bluffs of the Baraboo at the Narrows, at Spirit Lake, and at Garrisonville, are mainly composed of quartzite.

At the latter place, just back of Mrs. Garrison's house, the quartzite forms the top of the bluff, while at the base, the sandstone seems only slightly changed, and furnishes a building material of excellent quality.

On the opposite bank of the river the rock is unchanged, but a band of limestone occurs in it so pure and extensive as to be quarried and burnt for lime. This is located on land owned by Mr. Eiky, and is the only instance of the discovery of good lime in the Potsdam sandstone of this State.

The quartzite is magnificently developed at Spirit Lake, where it rises 500 feet above the water, in almost perpendicular cliffs, whose lower portions are concealed by huge masses which have fallen down from above.

Veins of milky quartz, sometimes containing geodes lined with fine crystals, traverse the quartzite in many localities, without any constancy of direction. Associated with these are also veins of specular and titaniferous iron ore.

This ore is very irregularly distributed, but follows the general course of the quartz in its passage through the rocks. It is not, however, confined immediately to the vein but isolated bunches of it occur in the quartzite adjacent to the vein.

It is usually made up of thin laminæ, slightly waved and cleaving readily apart. The planes of lammation intersect each other in all directions, giving to the mass an appearance like some of our lead ones.

It is very brittle, slightly magnetic and has a brilliant submetallic luster and lead grey color. No perfect crystals occur but crystalline faces are occasionalls observed.

I have examined these veins with considerable care but have been unable to discover the ore in sufficient quantity to be of value. It was supposed by some to contain silver and analyses were reported to have been made which discovered a large per centage of that metal. I therefore submitted it to analysis, and it proves to be a specular and titaniferous iron ore, containing some tungsten.

This mineral is usually associated with igneous rocks, and volcanic emanations, and may have been introduced by the same agencies, which have vitrified and upheaved the sandstones of the Baraboo.

The region in which it occurs deserves a careful and minute study, which it will be my aim to give it at an early period.

The ores that I have described include all those of any considerable value yet discovered in the accessible portions of the State.

From specimens brought to me and information gathered from reliable sources, I have reason to believe that large and valuable beds of ore exist in the unsettled districts of the North.

These deposits are valueless now on account of their distance from navigable waters, or other modes of *transportation.*

This region is now about to be opened by the Chicago Fond du Lac and Lake Superior R. R., and the means will thus be furnished for bringing the resources of this hitherto neglected and almost unknown country within reach.

A thorough exploration of the Western portion of the State will be the first work of the survey next season.

MANUFACTERE OF IRON IN WISCONSIN.

It has been shown that we have an abundance of good ores capable of being cheaply mined, reduced, and transported.

It is proper now to consider to what extent these ores can be profitably used in the manufacture of iron in our State.

The question fairly stated is this: Can iron be made from these ores, on the ground, as cheaply as iron of the same quality can be imported from those mines, which now mainly supply our market.

A comparison of the cost of making iron here, and the cost of imported iron, will enable us to reach a conclusion not far from the truth in prosecuting this enquiry.

Unfortunately, however, the elements of such a comparison are deficient on our side, as the production of iron thus far has been confined to a single furnace which has only been in operation a short period and devoted wholly until recently to pig metal. Still enough has been done to indicate the feasibility of a large home production, when our iron works shall have become fully established. The following estimates will show what can be done here in producing pig iron.

Estimate of the cost of producing a ton of pig iron from the Iron Ridge ore:

2 1-4 tons of ore at 75 cts per ton.	$1 70
150 bushels of charcoal at 5 cts. per bushel.	7 50
Fluxes if used.	1 00
Labor.	4 00
Carting iron to R. R. dept.	50
Management, Interest on capital, &c.	1 00
	$15 70

Cost of producing a ton of iron from Black River ore:

2 1-2 tons of ore at furnace.	$1 50
170 bushels of charcoal	8 50
Fluxes.	4 00
Labor.	4 00
Cartage to flat boat per ton.	50
Management, Interest on capital, &c.	1 00
Total.	$19 50

The cost of iron at Black River is increased nearly $4 per ton over that of Iron Ridge, by the expense of lime for flux, and also of fuel. A considerable reduction in these items will take place when the railroad communication is perfected to that point. As to the local market, its inland position will afford it a protection quite equal to this increased cost.

These estimates will not vary much from the actual results, though in some minor particulars they may be found incorrect, as the cost of labor, fuel, &c. is subject to fluctuation.

The following figures show the cost of making pig iron in those districts where it can be produced most cheaply at present, and which consequently control the market:

Scotland. (scotch pig.)	per ton.	$12 50
England and Wales.	"	18 75
New York.	"	18 50
Ohio.	"	18 00
Pennsylvania.	"	16 00

To these prices we must add transportation and duty to the foreign iron, and transportation to the American iron.

The former at present quotations, are selling at 28 to 35 per ton and the latter, about 30 to 33. As prices are now ruinously low, we may safely take these figures in our comparison. According to these prices we have an advantage of from $10 to $18 per ton, over any other furnaces whose products are sent to our market.

An expenditure of $10 per ton more than the cost of pig iron, turns the ore into castings of every description, without the expense of smelting.

The manufacture of bar iron has not been attempted as yet in our State, and the impression seems very general that we must always import it from abroad. It is difficult to find any support for this conclusion. The capacity of our ores to produce good bar iron and steel is undoubted, and there is nothing in the nature of things to prevent their being used for these purposes,except the want of capital and skill,to bring out thier latent value.

The making of bar iron is neither so intricate nor so expensive a business as to be monopolized. The following condensed remarks from "Overmans Treatise upon the Manufacture of Iron" will enable those not practically familiar with this subject to judge for themselves, as to the practicability of establishing this branch of iron manufacture.

"Pig or crude iron is converted into wrought or bar iron by refining, forging, or drawing.

Considerable wrought iron is also manufactured directly from the ore.

The difference in the quality of wrought iron consists mainly in its different degrees of ductility and malleability. Good wrought iron is nearly pure iron with a mechanical admixture of cinder. In most kinds of commercial iron we find from one quarter to one half per cent. of carbon, more or less sulphur, silicon or silex, phosphorus, manganese, and in all Swedish iron, more or less arsenic.

The nature of wrought iron is seen by examing the operation of puddling. In melting crude iron in a puddling furnace it comes in contact with cinder, containing oxides of iron manganese. In mixing the fluid or semi-fluid iron with this cinder, it will cause the oxidation of such substances as are more easily oxidized than iron, which of course diminishes the fusibility of the metal.

Constant work and mixing cinders with it prevents the formation of large crystals, and the metal crystalizes and adheres by cohesion in small particles, forming a soft spongy mass. The large pores in this mass are filled or covered with a coating of cinder, and when compressed by squeezing or otherwise, form a mixture of iron and cinder.

In drawing or stretching such a condensed mass, the crystals are elongated, form threads, and these together with the oxidized matter which keeps them apart form the fibre of the iron. We thus see that the fibre is the result of a particular form of metal, and may be produced with very impure iron, which notwithstanding its impurity, may be very strong.

Strength depends upon the fineness of the fibre. In many parts of the United States wrought iron is manufactured direcly from the ore in bloomery fires.

Large quantities of iron are made in this manner in New England, New York, Pennsylvania, New Jersey, Michigan and other States.

A small capital only is required to work these forges, and where ore is cheap they are profitable. The quality of the ore determines in a great measure both the quantity and quality of the iron. Only rich ores can be used with success. A large bloomery will make about 2000 pounds of iron daily, at a cost of about $35 per ton. This article is generally purer than puddled iron and very suitable for small iron. This mode of manufacturing is sometimes called the Catalan method.

All experience however has shown that first rate pure and uniform iron cannot be made directly from the ore nor from hot blast iron in competition with the foreign prices. The iron most in demand and for which best prices are obtained is wire iron, steel iron, and iron for the use of hardware manufacturers.

The cost of making iron of course varies very much, and the following estimates are only applicable in a general sense.

Ore is obtained in some localities at 75 cents a ton of 2240 lbs., in others it costs $4, and even higher prices are paid.

Hematites and all hydrated oxides work cheapest in the furnace. The ease of melting one kind of ore so much exceeds that of others, that a very marked difference in price is no objection to using the most expensive kind. Some furnaces in New England pay as high as $10 per ton for ore, but it is not uncommon to see sufficient ore for a ton or iron brought to the furnace for $1.

The amount of flux (which in most cases is limestone) varies from 1-2 to 1 1-2 tons to a ton of iron, and is furnished at from 50 cts. to $5 according to location. Fuel differs much in price and quality. From 130 to 200 bushels of charcoal are required to smelt the ore for a ton of iron, the price of which ranges from 5 to 8 cents per buushel. One ton and three quarters to two tons of anthracite, answer the same purpose.

In case raw bitumunous coal is used an amount equal to that of anthracite is required; and as this coal may be obtained very cheaply in some of the Western States, the advantages of that region for manufacturing iron are very obvious. An equal amount of coke to anthracite is required per ton. Smelting a ton of coke iron, where the coking is included, costs $3 to $4 per ton. Iron may be refined in a run out fire with a loss of 8 to 10 per cent., the use of half a ton of coke 60 bushels of charcoal, and at an expense of $1,00 for labor, and $1,00 for general expense. Puddling is done from $3,00 to $4,50 for labor per ton of iron, with a waste of 3 15 per cent. and consumption of 1400 pound of coal. When the balls are hammered, the hammer man receives $1,00 per ton. Drawing of the blooms into rough bars costs about 40 cents a ton.

In re-heating, from 3 to 10 per cent. of iron is burned, 400 pounds to one-half ton of coal used, and 50 cents to $1,00 in wages is paid to furnace men. The drawing at the rollers costs in wages about $1,00 for heavy bar, $2,00 for common bar, and $5,00 for small iron. The general expenses in a rolling mill are high, because of the extensive machinery, heavy capital, and vicissitudes of trade. It may not be too high if we assume $6,00 as an average expense per ton of bar iron.

The expense of rolled sheet iron can hardly be estimated correctly, but $10,00 per ton for fuel and wages may be near the amount. The amount of iron produced in the United States is estimated at about 800,000 tons per annum. The labor of 250,000 persons is required to manufacfure it. The consumption of iron is 1,100,000 tons annually,—300,000 tons of which are imported from Europe. One-third of all the iron manufactured in the United States, comes from Pennsylvania, whose furnaces are capable of yielding 500,000 tons per annum.

From the above remarks it will not be difficult to calculate nearly, the cost and conditions of making iron, at any given locality. Let us now examine the prices of bar and rolled iron with which our furnaces and forges must compete. The present New York quotations are as follows:

English bar,	$ 55	to	$70	per	ton.
American rolled,	60		62	"	"
Swedes iron,	100			"	"
Railroad iron,	65			"	".

About $12 per ton must be added to these prices, for transportation to our market.

The following table exhibits the prices of English bar iron during 7 years, from '43 to '50. They were prepared by the U. S. Treasury Department:

1843,	$57,45	1847,	$65,17
1844,	53,12	1848,	56,83
1845,	58,05	1849,	44,57
1846,	74,76	1850,	43,12

This table covers a period during which iron was lower, than ever known before or since, and we may safely calculate its average as expressing the full extent of competition, which the American manufacturer must encounter.

The price of railroad iron ranges from $50 to $80 per ton in New York. It is mostly brought from England and is usually made of an inferior iron. Considerable railroad iron has been made of late in New Jersey and Pennsylvania. A very general opinion seems to have obtained, that the manufacture was very complicated and difficult. This opinion is without foundation. Mr. Overman remarks that "the making of rails may be considered the most pleasant and easy branch of iron manufacture."

There is no good reason why every mile of western railway should not be laid with Wisconsin iron.

Upon the home manufacture of railroad iron I am glad to be able to quote such authority as that of James Buchanan, the present Chief Magistrate of the United States. The following remarks were made by Mr. Buchanan, on the floor of the U. S. Senate, in 1844:

"Railroad iron is not to be confounded with articles of trade. It comes in to form the material of our highways, stretching over thousands of miles, and to be lengthened still more from year to year; not simply to be constructed once, but to be renewed from time to time.

"It is not more possible for any country to sustain itself under a course of importations for such a purpose, than in the importation of materials for its houses, and the fences on its farms. Whatever measures are required, to secure the early and effectual manufacture of this article here, should be promptly applied. But it has been asserted that railroad iron has not been, and cannot be, manufactured in the United States, even at present prices, the duty included.

"But why has not this iron been manufactured in our country? Is it for want of capital, skill, or enterprise? Surely this will not be contended. There is no mystery in the manufacture of railroad iron. It is a very simple process. We are informed by Mr. Oakley, of the New Jersey Iron Co., that, 'there is no difficulty in making railway iron, or much less than in making many other kinds, which have long been produced in this country.' All that I have heard or read upon this the subject, coroborates the truth of this opinion.

"I confess, sir, that I have a little American feeling upon this subject. As an American citizen, I cannot brook the idea that we shall be dependent upon Great Britain for the very materials necessary to construct the roads on which we travel. Surely, American railroads ought to be constructed of American iron."

These sentiments are the expression of a genuine patriotism, and do honor to their distinguished author.

The market for our iron is by no means confined to our State. There are no valuable iron ores in the Northern part of Illinois, in Eastern Iowa, or in Minnesota, as yet discovered. We have thus an extensive district, much of it already densely populated, and all of it capable of sustaining a dense population, which can be supplied with iron from our ores, more cheaply than from any other quarter. This district includes the great cities of Milwaukee, the metropolis of Wisconsin, and Chicago, the metropolis of the Northwest, and holds a popupulation of 2,100,000 people. Its annual consumption of iron in various froms of ordinary use, cannot be less than 22,000 tons Allowing it to build 300 miles of railroad per annum, and adding the consumption of iron in rerolling of old track upon the 2,000 miles of road slready completed, once in ten years, and the annual demand for railroad iron will not fall short of 35,000 tons. The entire demand for iron will therefore be about 57,000 tons, the market value of which will be not less than $2,280,000.

This may seem a very large amount in the aggregate, but let any one sit down and calculate the amount of iron in all the stoves, ploughs, tools, machinery, pipe, railroad bars, and other fabrics of iron, used in the four or five great States which we may include in the limits of our market, and he will soon convince himself that it does not exceed the actual consumption.

This extensive demand will of course increase with the population, wealth, and facilities of intercommunication. New applications of iron are constantly being made, and these will be more numerous with the advancing civilization of the West.

But whatever extension this demand may take, our capacity to supply it will never be exhausted. We have ore enough above water, and within easy reach, to make 14,000,000 tons of iron. At 100 tons per mile, this would build five lines of railway around the globe, and still leave enough for 15,000 miles at home. The entire annual consumption of the United States, could be supplied from our ore beds 12 yesrs, without exhausting them.

Suppose the four States of Wisconsin, Illinois, Iowa and Minnesota, to use 60,000 tons annually, we could supply these States with their iron for 233 years.

Our fuel too, is no less inexhaustible. We have an immense wooded district in the north from which charcoal can be obtained for present wants. A little distance south of our border, in Illinois, lie the exhaustless coal beds of the great

La Salle basin, from which *must* come our permanent supply of fuel* for the reduction of ores, and the heavy processes of manufacture.

We have cheap motive power, abundant facilities of water and railroad transportation, fireclay, fluxes, and every material requisite for manufacturing iron.

With bounteous hand the Great Providence has filled the earth beneath our feet with ores, stowed away in its secret repositories, or spread out upon its suaface, exhaustless supplies of fuel; scattered in profuse abundance fluxes of every kind; dammed up the channels of the rivers for water powers; and above all, conferred upon man the inventive intellect, to combine and organize all these elements, and evolve therefrom a thousand forms of use and beauty. We have as yet scarcely begun to learn the extent of these magnificent provisions. We send thousands of miles to foreign lands for iron rails, and lay them down over our beds of ore. We turn over the soil, red with iron, we stir and cultivate it, with ploughs, and harrows, and hoes, made of foreign stock. We thus in our ignorance, insult nature and spurn her richest gifts. Why should we thus waste the best portion of our glorious heritage? We have imported into the West nearly 300,000 tons of iron during the last 10 years, worth $20,000,000, at $40 per ton. How much this would have done to build up our own industry, had it have been expended at home!

I am not willing to admit that American skill is so inferior to European, that we cannot find means of converting our ores into articles of the most common use, as cheaply as they can be made three thousand miles away, out of similar material, and brought to our market.

Our elder brother of the Saxon race has come to us to learn many things more difficult than this, and he is proud to acknowledge the debt, for it is in his own family. We taught him steam navigation. We have worked up his iron into locomotives, which have never been equalled for speed, strength, or draft, and which to-day are vindicating American skill and genius on the iron highways of Europe.

*See page 48.

The Old World does tribute to the capacity of our engineers, by employing or consulting them on its grandest works. The American Engineers are reflecting more lustre upon our country's fame abroad, than all its foreign representatives, or its army and navy combined. In the improvements of machinery, and processes of manufacture, in all that gives evidence of progress in science and art, we have stood side by side with the most advanced people across the water.

A few weeks since a small party met, by invitation, at the magnificent iron works of FRANCIS ALGER, Esq., in Boston, to witness the casting of one of those great cannon, which they are daily turning out from that establishment, for the use of the American navy. Among other distinguished persons present were Col. Fremont, Dr. Jackson, and Sir Charles Fox, the latter gentleman an Englishman of great celebrity, and intimately familiar with such operations in his own country.— It was with feelings of patriotic pride, as an American, that I heard the generous Briton applaud the beautiful and connected mechanism of the works, and admit the superiority of the guns to any yet made in England.

Every gun used in the English service is marked condemned, when it has been fired 750 times. Our guns can be safely fired more than twice that number of times. Mr. Alger is willing to warrant his guns to stand 1,500 charges in proving. (The theory is that every cannon will burst sooner, or later, as each discharge changes the crystilization of the iron and weakens it. Hence the danger of using old condemned guns, at celebrations, &c.)

His guns are made entirely of American iron, and he has succeeded in giving it this wonderful tenacity, by combining scientific knowledge and practical skill, in a course of long continued and careful experiments.

With such results as these before us, we cannot doubt that our country can achieve its independence of foreign sources of supply, in its iron fabrics. In this work our young State, so full of energy and capabilities of good, must do its part.—

To this end our resources in this direction must be made known; tha value of this interest must be impressed upon our people, and such a patriotic feeling aroused, that we shall give the first preference always to our own iron.

The State in its organized capacity might properly use only Wisconsin iron in the erection of its public buildings, and exempt all iron works from taxation during a reasonable period after their establishment. With such encouragement, and under such a state of public feeling, capital will flow in this direction, and the production of iron and iron ware will become one of the great interests of our State.

We have now only three furnaces, and produce only a few thousand tons of pig metal per annum, but we are to remember that from small beginnings like this, the mighty iron and coal trade of Pennsylvania and other States, has grown up. Anthracite coal was esteemed worthless as dirt, till Yankee ingenuity, a few years ago, found out it could be burned; and the best ores now used were, many of them, tried repeatedly, and pronounced worthless. Time, energy, and perseverance have done all that we see in the iron trade of Germany, of England, and the most advanced portions of our own country. The original conditions are here as favorable as they were at first in those places, which have succeeded so well. They have some advantages over us, and we can boast others of equal value over them.

It is well to consider the value of this trade in sustaining and fostering other branches of industry. Agriculture is the great paramount interest of our State; but its prosperity depends not less upon the marketing, than the raising of crops. All experience has shown that the market created by home manufactures, is far better and more reliable, than any other.

We have a fine illustration of this in our vast pineries, and their influence upon agriculture. Whatever the state of the foreign market, the pineries have always absorbed large quantities of farm produce at high prices.

Look now at the splendid farming district bordering Lake

Winnebago, and the Fox and Wisconsin rivers, studded with beautiful homes and thriving towns, radiant everywhere with evidences of wealth and prosperity, and you have a triumphant vindication of the value of a home market.

The agricultural counties of the central part of the State are quite as much indebted to the lumber interest for their rapid growth in population and wealth, as to their natural fertility and beauty. It is a matter of vital importance to our farmers to secure a market for their surplus products. These products are being multiplied more rapidly than the old sources of demand. The emigrants who once used our surplus, have settled and become producers. The pineries are supplied and the home market is exhausted. The same process is going on in the great agricultural States around us, tending still to aggravate the difficulty. We are thus largely dependent upon a distant market, both as buyers and sellers. Our remedy is to multiply the variety of home products, and encourage home manufactures.

Every ton of pig iron manufactured consumes $10 worth, and every ton of bar iron, $26 worth, of agricultural products. If this iron is worked up into tools, utensils, and machinery the amount of consumption per ton will of course be greatly increased. If therefore our iron mines were worked upon a scale equal to their capacity, and the legitimate demand which they can supply cheapest, a home market of at least $1,500,000 worth of agricultural products would be created.

This vast sum thus kept at home, would not only do much to sustain and advance our agriculture, but to rear side by side with it a diversified manufacturing and mechanical industry, supplying the wants and increasing the comforts of our people.

If we would prosper permanently, we must do everything possible within ourselves. Whatever the Creator as given us in soil, mine, forest, lake and river, that is so much fundamental capital which we are to make the most of, if we would carry out the designs of nature, and reap the reward. When we have improved all our resources to their fullest extent, and exhausted invention in attempts to create new values, there will still be enough that we shall need, and cannot produce, to sustain our foreign and domestic trade, and help to "wind the silken chain of commerce round the world;" and more, what will be well, both for our reputation, and our pockets, we shall then have means to pay our distant neighbors for what we buy of them.

Iron is truly one of the precious metals. Its production enriches without demoralizing. Its returns are sure and steady, coming as the legitimate fruits of capital, skill and labor united to master the secrets of nature, and unravel her subtlest combinations.

Our iron mines are more precious than veins of gold. Spain owning half the New World, sending her ships accross the sea with every favoring breeze, guarded by invincible armadas and loaded with the gold of her provinces, dispised her iron and drove away her craftsmen.

England shut up in her island home, wrought silently among her mountains of iron, and supplied every market with her fabrics and her wares.

Look now at the noble, growing, and benificent civilization of the one: Contrast it with the rottenness and decay, verging fast upon dissolution, of the other.

The expansion and development of our iron interest is well worthy of the serious attention of the State. It, will add largely to our wealth, population and prosperity; it will enlarge our material dominion and give us commercial independence, and by introducing a new element into our industry, exert a healthy and prosperous influence upon the inventive genius of the people.

A people devoted to a few simple pursuits cannot permanently maintain a high intellectual character. The varied talents and tastes found in the different members of every family, require each its specific vocation.

A diversified and refined industry,gathers up and distributes every germ of mind, gives to each the place best suited to his capacity, and thus secures the completest education of the general intellect. The rich and varied resources of our State were designed not only to furnish us the means of physical comfort, but also to offer a field for the culture of that higher nature, for whose transient home the great globe itself was brought into being.

COAL OF NORTHERN ILLINOIS.

I present below a few facts pertaining to the Coal deposits of Northern Illinois, which have an important connection with our supply of fuel; especially that portion of it required for the manufacture of iron.

The most important of these deposits to us, is that located at La Salle, on the Illinois river, about seventy-five miles south of our State line. It consists of three seams, one six feet, one five feet, and one three to four feet thick.

I made, some time since, a thorough examination of this coal district, and am fully convinced that its immense resources can hardly be over estimated. The La Salle coal basin is about twelve to eighteen miles in diameter, and contains not less than 150,000,000 tons of coal. This basin is situated at the terminus of the canal, and at the head of steamboat navigation on the Illinois river. It is also traversed by the Rock Island and Illinois Central Railroads. It has, consequently, the most extraordinary facilities for shipping coal.

The Illinois Central Railroad runs north from La Salle, and connects with the Mississippi river at Dubuque, with the Galena and Chicago Railroad at Freeport, and through it with the Madison and Beloit Railroad, Milwaukee and Mississippi Railroad, and all the Roads which intersect the southern portion of our State. We are thus brought into immediate connection with these coal deposits, from which, at no distant day, we must derive a large share of our fuel.

I extract from the Annual Report of O. N. Adams, Esq., the capable Superintendent of the Little Rock Mining Co., the following table of analyses, and accompanying remarks, which enable us to decide by close comparison with other standard coal, upon the value of this.

"The coal of the lowest seam will compare favorably, for manufacturing or domestic purposes, with the best coals of Ohio and Pennsylvania, as shown by the following

Comparative Table of Analyses.

STATE.	LOCALITY.	DISIGNATION OF COAL BED.	ANALYSIS. Fixed Carbon.	ANALYSIS. Volatile Matter.	ANALYSIS. Ashes.
Penn'a ...	Blossburg, ...	Blossburg, ...	62 80	32 80	5.20
"	Venango Co., ...	Sandy Ridge, ...	49 80	43 20	7.00
"	Crawford Co., ...	....	59 46	38.75	1.80
"	Mercer Co., ...	....	57.80	40.4[illegible]	1.70
"	....	Ormsby, ...	6[illegible].40	33 20	2.40
Ohio	Summit Co, ...	Upsons, ...	53.40	44.30	2.29
"	Hammondville, ...	Strip Vein 1st Analysis, .. 2d Analysis, ...	 70.80 65 60	 26.40 29.20	 2.80 5.20
"	Briar Hill, ...	Briar Hill, ...	58.41	38.1[illegible]	3.46
Illinois	La Salle Co., ...	Little Rock, "Lower Bed," 1st Analysis, ... 2d Analysis, ...	 53.20 57.60	 44.00 38.40	 2.80 4,00
"	La Salle Co., ...	Little Rock, "Upper Bed," 2d Analysis, ...	 48.80	 39.60	 11.60

The coal from the Little Rock Company's shaft on the lower bed, has given general satisfaction for all domestic purposes. Whether used in open grates or close stoves it burns freely, leaving but little ashes, and scarcely forming any clinker.

The cost of mining this coal and putting it upon cars or boats, is about $1,15 per ton. As the coal trade assumes magnitude and permanence, it can be raised from ten to twenty cents per ton cheaper than now. This coal now sells at $3 per ton at the top of the shaft; cost of transportation to Chicago by canal, 60 cents per ton!

The demand for the coal during the past two years has been fully double the supply.

Dr. Norwood, the very able Geologist of Illinois, says of this coal district:

"The position of the La Salle basin is not surpassed by that of any other in the West. It is connected with Lake Michigan and the Mississippi river by means of the Illinois river and the Canal. It is also intersected by the Illinois Central Railroad, giving a connection with both northern and southern markets; and by the Chicago and Rock Island Railroad, giving it access to markets both east and west. Thus at no time need you fear an overstock in the market, as you can send your coals in all directions, both winter and summer, and the demand will always be equal to the supply.

The accompanying table of analyses of Illinois Coals, compared with those of other well known coals, will enable any one to judge of their relative value. I send also a table of a few foreign coals, which bear a high reputation among manufactures of iron. I do this because the iron ores of the North are very abundant, and can be made accessible to the La Salle coals.

NORTHERN ILLINOIS COAL.

NAME OF COAL.	COUNTY.	Specific Gravity.	Moisture.	Volatile Gases	Carbon in Coke.	Ashes.	Carbon in Coal.	Color of Ash.
Watson's Mine......	Grundy,	1.259	9.0	36.5	47.8	6.7	51.3,	Pink.
Turner's,* (Morris)	"	1.227	7.0	41.5	49.0	2.5	54.1	White.
Marseilles........	La Salle,	1.3144	5.0	40.6	33.4	21.0	47.0	"
Ottawa,†.........	"	1.2672	7.8	35.9	52.3	4.0	54.6	
La Salle Basin,								
(Lower Bed,)								
Ireland's,.........	"	1.237	6.8	39.9	50.3	3.0	55.1	Grey.
Seeley's,..........	"	1.2234	8.0	34.6	41.4	16.0	53.0	Red.
Field & Rounds',...	"	1.222	6.7	41.4	46.7	5.2	53.4	Red.
Hartshorne's,......	"		4.9	37.6	49.7	7.8	54.16	Brown.
Hitt's,............	"	1.2985	4.5	42.4	40.3	12.8	47.5	White.
(Middle Bed.)								
Big Vermillion,....	"	1.242	12.0	39.4	47.1	1.5	54.8	
Kirkpatrick's,.....	"	1.202	7.0	41.2	49.3	2.5	54.6	Grey.
Egleston's,........	"		5.5	42.75	48.45	3.3	52.53	Grey.
(Upper Bed)								
La Salle Coal Mining Co.,........	"		6.5	36.43	50.07	7.0	54.39	Brown.

ANALYSES OF FOREIGN COALS, USED IN THE MANUFACTURE OF IRON.

COUNTRY.	LOCALITY.	NAME OF BED.	Volatile in Coking	Carbon,	Ashes.	Color of Ash.
England	Forest of Dean,	Linderford,	36,00	62.	2.	Red.
"	Parkend,	"	39.00	58 5	2.5	Ochre.
"	Coleford,	High Delf,	32.03	63.72	4 25	Red.
"	Starkey,		46 72	61.53	1.75	Red.
"	S. Staffordshire,	New Mine Top,	45.100	52 775	2 125	Pink.
"	"	Fire Clay,	46 35	52 40	2 25	Buff.
"	Bentley,	Ten Yard,	34 18	63 57	2 25	White.
"	Lane End,	Bassey Mine,	38.70	58 30	3 00	Pink.
"	(N. Staffordshire)					
"	Lane End, (*best*					
"	*furnace*,)					
"	N. Straffordshire,		32 30	65.20	2.50	White.
"	Golden Hill,	Spendcroft,	39.58	58.67	1 75	
"	"	Little Row Bed,	34 53	62.47	3.00	Grey.
"	Shropshire,	Randle Coal,	32 81	64 19	3.	White.
"	"	Double Coal,	41.38	57.87	.75	Fawn.
North	Brymbo	Three Yard,	35 70	62.70	1.6	Light.
Wales	"	Brassey Vein,	34.100	64 582	1.318	Grey.
England.	Churchway,		35 67	60.33	4.	Brown.
"	"		34.740	64.135	1.125	Fawn.
"	S. Staffordshire,	Corbyn's Hall,				
"		(Ton Coal,)	40.6	51.9	7.5	Grey.
"	"	Corbyn's Hall,				
"		(Heathing Coal,)	43.83	54 17	2.50	Buff.
"		(Bottom Vein,)	32.	62.870	5 125	Pink.
"	" Bentley,	(5 feet Splint Coal,)	45.83	49 42	4.75	Red.
"	N. Staffordshire,	Ten Feet Coal,	39.11	58 89	2.	Grey.
"	Golden Hill,	Great Row Coal,	37.70	60.80	1.75	Grey.
"	"	Little Row Coal,	34 53	62.47	3 3	Grey.

H. C. Freemen, Esq., the skillful mining engineer, and manager, of the LaSalle Coal Co., says in a late report:

"The lower bed compares favorably with coals of high reputation. The middle or six feet bed is scarcely inferior, and its greater thickness will render it more profitable in working. The seam of Cannel coal in connection with it gives it additional value. We have been using this coal for eight months, in our engine, and find it an excellent coal for generating steam. In burning, the residuum is coke and cinders, and leaves the grate bars perfectly free and clear."

Mr. Freemen informs me that the LaSalle coal is now being used at Galena and Dubuque in the gas works of those towns.

There can be no question as to its adaption to iron manufactures.

Bituminous coal is very largely used for this purpose, both raw and coked, in many parts of the globe.

In a letter just received from James C. Clarke, Esq., Gen. Supt. Ill. Central R. R., he states:

"In May, 1856, I ordered some slight changes to be made in an ordinary wood burning engine, for the purpose of testing the practibility of using Illinois coal as fuel for the locomotives of this company. This engine was run upwards of a month doing regular service, making 16,600 miles. The experiment was so satisfactory, that this company ordered 20 coal burning engines, which are now in use. Nearly all our freight trains are run with coal burning engines. They are working well, and give entire satisfaction, at much less cost for fuel than engines burning wood.

The lower vein at LaSalle is quite free from sulphur and other objectional matter. There is no doubt in my mind that it will eventually be used as locomotive fuel in all northern Illinois.

The LaSalle coal basin is being rapidly developed. I enclose a tariff of prices, adopted by this line. You will observe that it is based upon a sliding scale, discriminating in favor of consumers at a distance.

In reply to your enquiry as to "what this company would carry iron ore for; I will say upon the same terms as coal.

We feel dispored to foster the mineral traffic as far as possible. In adopting our tariff, we did not look to the immediate revenues to be derived from the traffic, but rather to the development of the coal fields, and the increase of mining population along our line."

"I speak of this coal matter from an experience of 10 years on the Baltimore and Ohio R. R. and in the coal regions of Maryland."

By the tariff of prices alluded to, coal or iron ore carried 120 and under 150 miles is charged 1 3-4 cts. per ton per mile; 150 miles or over; 1 1-2 cts. per ton per mile.

The liberal and enlightened policy adopted by the Ill. C. R. R., looks to ultimate rather than immediate results, and offers substantial encouragement to the opening of our mines of coal and iron.

I append a few tables and accompanying remarks, from Overman's great Work upon iron. These are of great value, too, in a practical point of view, both to the public generally and to iron mongers, as furnishing valuable data for judging of the relative value of different kinds of fuel.

The specific gravity of the different kinds of wood, is of the first importance. This is the proper criterion of their value, though wood is generally bought by measurement. Its specific gravity is directly in proportion to its amount of carbon, hydrogen, and oxygen. The following table shows the specific gravity of wood, water being the standard unit, and the relative value of the most common varieties:

TABLE SHOWING THE VALUE OF WOOD.

Kind of Wood.	Specific gravity of Wood.	Pounds of Wood in a cord, Adp.	Per centage of Charcoal.	Specific gravity of the Charcoal.	Pounds of Charcoal in a bushel.	Bushels of Charcoal from a cord of dry Wood.	Relative value of dry wood. Hickory 1.
White ash,	.772	3450	25.74	.547	28 78	31	.77
White beech,	.724	3236	19.62	.518	27.26	23	.65
Butternut,	.567	2534	20.79	.237	12.47	42	.51
Red Cedar,	.562	2525	24 72	.238	12 52	50	.56
Chestnut,	.522	2333	25.29	.379	19.94	30	.52
Dogwood,	.815	3643	21	.550	29.94	26	.75
Shell-bark hickory,	1 000	4469	26 22	.625	32 89	36	1.00
Hard maple (sugar),	.644	2878	21.43	.431	22.68	27	.60
Soft maple,	.597	2668	20.04	.370	19 47	28	.54
Magnolia,	.605	2704	21.59	.406	21.36	27	.56
Chestnut oak,	.885	3955	22 75	.481	25.31	36	.86
White oak,	.855	3821	21.62	.401	21.10	39	.81
Black oak,	.728	3254	23 80	.387	20.36	38	.71
Red oak,	.728	3254	22.43	.400	21.05	30	.69
Yellow Pine,	.551	2463	23.75	.333	17.52	33	.54
Jersey Pine,	.478	2137	24.88	.385	20.26	26	.48
Pitch pine,	.426	1904	26.76	.298	15.68	33	.43
White pine,	.418	1868	24 35	.293	15 42	30	.42
Poplar, yellow,	.563	2516	21.81	.383	20.15	27	.52
Poplar, Lombardy,	.397	1774	25	.245	12 89	34	.40
Sycamore,	.535	[illegible]91	23.60	.374	19.68	29	.52
Blackwalnut,	.681	3044	22.56	.418	22.	31	.65

TABLE SHOWING THE VALUE OF COAL.

Kind of Coal.	Specific gravity.	pounds of coal in a bus. adp.
Lehigh coal,	1.494	78.61
Schuylkill,	1.458	76.46
Susqehanna,	1.373	72.25
Rhode Island,	1.438	75.67
Cannel Coal,	1.240	65.25
Liverpool,	1.331	70.04
Richmond,	1.246	65.56
La Salle coal,	1.416	75.42

The value of wood by measure, corresponds directly with its specific gravity after being dried in the kiln. Oak is, therefore, worth nearly as much again as pine for making charcoal.

This subject deserves the close attention of the Iron Master, for it is his business to select wood, and regulate its price according to quality. If a cord of hickory is worth one dollar, white oak is worth 77 cents, beech 65 cents, sugar maple 60 cents, white oak 81 cents, pine 54 cents, &c.

The comparative value of coal and wood may be gathered from the following table carefully prepared, and indicating the results of numerous experiments:

Coal at	$5,25	per ton,	equals best	wood at	$2,28
"	5,50	"	"	"	2,39
"	5,75	"	"	"	2,50
"	6,00	"	"	"	2,61
"	6,25	"	"	"	2,75
"	6,50	"	"	"	2,83
"	6,75	"	"	"	2,94
"	7,00	"	"	"	3.06

OBJECTS OF THE SURVEY.

A few general remarks upon the Geological Survey, may not be out of place at the close of this report.

The obects of this survey are to ascertain the character, position, thickness, and horizontal extent of the various beds of rock that occur in our State; to discover the location, quality, mode of occurrance, and amount of all valuable mineral substances; to examine the soil in various localities with a view to its agricultural capacities, uses, and the best means of improving it; and, in general terms, to collect, arrange, and publish all knowledge that can be obtained of the physical resources of Wisconsin.

By this means our own citizens, and the world at large, will be furnished with reliable information concerning our natural endowments as a State. The dissemination of such knowledge will invite population, hasten the development of our known resources of wealth, and at the same time open up new mineral treasures, as yet undiscovered. In this way every citizen is to be a sharer in the substantial benefits of the survey, and has a direct interest in its successful prosecution.

To accomplish these objects, the Geologist must visit every part of the State, and make the best examinations possible with the means at his disposal. In a State so large as ours, this must occupy considerable time, and therefore it is important that where points of special interest or value occur, they should be early noticed. In this particular, as well as in others, the co-operation of the citizens of the State will be of great value. If every intelligent person would carry out the following simple suggestions, he would not only be accumulating useful knowledge himself, but also advancing the Geological Survey, and contributing to science.

1st. Observe the character of the rocks, if any are exposed in your vicinity, whether they are arranged in layers, (stratified), or occur in irregular masses, (unstratified); whether they contain any curious petrifactions, or shapes of animals or plants in stone.

2d. If there are different beds of rock lying one above another, as sandstone, limestone, &c., note their thickness, extent upon the surface, and order of superposition.

3d. In excavations for railroads, canals, sinking shafts for wells, mining, &c., preserve specimens of the rocks, clays, soils, &c., of every foot in depth, and take careful minutes in writing, of the order in which they occur.

4th. Collect specimens of all rocks, clays, marls, peats, and all soils remarkable either for productiveness or sterility in your vicinity. These should be fair average specimens, and such as would afford, on examination, a test of the composition of the entire mass from which they are taken.

5th. Carefully preserve all petrifactions, and all bones, teeth, tusks, or other remains of animals found in the soils, clays, gravels or elsewhere.

6th. If beds of limestone, fit for marble; grindstone quarries; sand, which might be used for glass, &c.; clay for pottery; metallic ores; or any mineral substance which, in your opinion, might be valuable, occurs, collect and forward specimens of each kind.

7th. Where veins of ore are being worked, (in the "lead region particularly,) notice their length, direction, increase and diminution in thickness, as they traverse the rock, depth below the surface, and product of ore. Accurate drawings of particular veins which can be prepared easily by the practical miner, as he works them out, would be of great value.

8th. Let the owners of all works for the reduction of ores, furnish a statement of the amount of ore worked, cost and method of reduction, and pure metal produced, during the year.

9th. When quarries are being worked for building stone capable of being dressed or polished, let owners of such quarries prepare blocks or slabs, polished or dressed in the best style, and forward them to Madison. Such blocks should be at least 1 foot square and of the thickness of the layer to which they belong. They will be arranged in the cabinet of Economical Geology with the name of the owner, and will represent their locality for all time to come, in the State Collection.

It is of course for the interest of every quarryman to advertise his stone in this manner, and it would be a great public convenience, enabling any one to see at a glance, the building material of our whole State. Accompanying such specimen should be, a statement of the precise location of the quarry, distance from railroad or water transportation, cost of quarrying, and amount of stone accessible. This information will be filed in the cabinet, so that an architect may come to Madison and obtain such information as he needs for public or private purposes.

10. In general, collect all specimens, and facts, which in your opinion will be interesting or useful to be generally known.

Persons residing near locations where interesting petrifactions are attained, may do much for science by a little care. Very good local collections of that kind have been made by, Gen. Smith of Mineral Pt., I. A. Lapham, of Milwaukee, E. C. Hobart, City Engineer of Beloit, Henry Woolson, Esq., of Iron Ridge, and T. J. Hale, a talented young naturalist of Racine.

Specimens of rock or ores should be about 4 inches square. Petrifactions should be sent whole, whatever may be their size; if broken in extracting from the rocks, carefully preserve the fragments. Soil, sands. &c., may be put up in four ounce vials. Each specimen should be wrapped in paper by itself with a label, stating its precise locality, written with ink. When thus prepared, specimens may be forwarded in a box carefully packed, to the *State Geologist*, *Madison*, *in care of the Governor*. They may be sent by the member elect from each assembly district, who will no doubt see to their safe delivery as a matter of public interest, or forwared by any other means which may be thought proper.

All communications may be directed to E. Daniels, *State Geologist*, *Madison*, where they will be sure to reach me at any time.

NATURAL HISTORY.

The great naturalist, Prof. Louis Agassiz, is now engaged in writing and publishing his work upon the animals of America. Its completness will, of course, depend upon the unmber of specimens that he may may be able to examine. For several years, many public spirited persons have aided him, by collecting and forwarding specimens of animals.

It is certainly desirable that the animals of our State should have as large a place as possible in that work. New and strange animals are found, from time to time, which are lost, for want of a little care.

Let such persons, as are willing to aid the advancement of science, preserve in spirits, or otherwise, according to the nature of the specimen, everything which seems strange or new. Collect all the fishes of the streams, ponds, or lakes; also, the crawfish and shellfish, as well as, toads, frogs, lizards, turtles, snakes, insects, &c. These can be put into cans, bottles, or kegs, sealed and forwared, labeled with locality, &c., either to me, at Madison, or directly to Prof. Agassiz, at Cambridge, Mass. They will be properly acknowledged, and whatever is new among them will be named and described, in the forthcoming work of Agassiz.

As a matter of public interest, and connected with the Natural History of our State, I call attention to the labors of Dr. Weinland, a highly scientific German, now at Cambridge, and bespeak for him the co-operation of the friends of science. Dr. Weinland is fully endorsed, by Prof. Agassiz, with whom he was formerly associated in Europe, by Dr. A. A. Gould, of Boston, the distinguished Conchologist, Dr. Wyman, and the highest scientific authorities of the world.

I give an extract from his circular, and trust that in a matter of vital importance to the public health, as well as great scientific interest, he will meet the response that he merits:

"I have commenced writing a hand-book on the PARASITES OF MAN, comprehending all the parasitic (intestinal) worms, insects and plants (Fungi) that have been found in or on man.

This book is intended for the use of every person who would become acquainted with the interesting history and organization of this group of living beings, so much dreaded by, and yet so dependent upon, mankind.

Our view is this: that only a thorough zoological and physiological knowledge of these parasites can lead to a sound understanding of the pathological phenonomena which they produce in the human body, and, when necessary, to a successful therapeutic treatment.

Thus we shall, for instance, when beginning with the Helminthes, or intestinal worms of man, first give a full account of the nature and organization of Helminthes generally, of their embroyological development, their wanderings from one animal into another, from man into animals, and from animals into man, &c. Then on this theoretical zoological view will naturally be based the practical medical view, aiming at a thorough knowledge of all the different species that have been found in man, of the prophylactic against them, of the pathological symptons that indicate their presence in the human body, and of those remedies that have been proved successful.

One example may show how necessary it is for the practising physician, and for the people generally, to be acquainted with at least some facts of the embroyological development of these worms, viz:

We know now by experiment that one of the most common tapeworms of man (the Tænia solium), when eaten by a hog, produces in the muscles of the hog the measles (measly pork). We know that these measles contain the larvæ of that tapeworm, and that, if one of them is eaten by man, in an uninjured state, the larva develops itself into a regular tapeworm in the intestine of the man.

In the same manner the dog gets its tapeworms from the measles, found in the mesentery of the hare and rabbit, the cat, from those found in the liver of rats and mice, etc.

I would most respectfully solicit your assistance, and ask of you to send me specimens of the parasitic worms of man and animals. Any specimens sent to me, even the most common, will be highly acceptable, and thankfully acknowledged in my work. The common earthworms, which are generally considered as one species (Lumbricus terrestris, L.), but of which we have undoubtedly a number of different genera and species in the United States, and the hairworms (Gordius aquaticus, L.), which show an extremely interesting embryological development, are also much needed from the different parts of the country for careful examination. Living specimens would be very valuable. Parisatic worms may be kept alive for several days in the white of an egg, hair worms in water, and earthworms in moist earth. To send them alive is of course possible only in the warm season. Dead specimens can be forwarded in small phials with alcohol of about 60 per cent., or with common whiskey.

Any specimens you may be able to send, please forward by express to Dr. D. F. Weinland, at Prof. L. Agassiz's Zoological Laboratory, Cambridge, Mass.,—labelled concerning the locality or the animals in which they were found. Also other remarks, which you might deem useful, would be gratefully received.

Trusting that my labors will prove worthy of the support of my scientific friends, I subscribe myself,

Respectfully, yours,

DAVID F. WEINLAND.

CAMBRIDGE, Mass., October 27, 1857.

EXPENSE OF GEOLOGICAL SURVEYS.

As it has been supposed by some persons that our State had made very large expenditures in Geological surveys, with small results, as compared with other States, I give below some facts which will enable every one to judge intelligently upon this point. The three Western States nearest us, who have surveys of this kind in progress, are Missouri, Illinois, and Iowa.

The Geological survey of Missouri was commenced in 1853 with an appropriation of $10,000 per annum, under the superintendence of Prof. Swallow. About $40,000 have been expended, and two very creditable annual reports published. Iowa has an appropriation of $5,000 per annum. The survey hrs been conducted by Messrs Hall and Whitney and has been in progress three years. No report has yet been published, but I understand one will soon appear.

The Geological survey of Illinois has $6,000 per annum. It began in 1852 with $5,000, but has since been increased. Dr. Norwood its able chief has made only reports of progress, but has a large amount of materials for an interesting and valuable final report.

Our own survey was commenced in 1853 with an appropriation of $2500 per annum for four years. Of this appropriation, about $7000 was expended.

The work was interrupted by the death of Dr. Percival and as the appropriation was too small to sustain a creditable survey, it remained suspended during 1856. Last winter the survey was revived with an appropriation of $6,000 per annum for six years. I was entrusted with one department of that survey. Under my contract with the State, I have drawn from the treasury $1,997 91 during the year 1857. This covers all the expenses of my department for that year, including outfit, team, transportation of specimens, fitting up rooms, assistance, together with the cost of analyzing the iron ores, which was necessary in order to determine their value, before the publication of my report.

There has been no other expenditure in this State, for Geological surveys than those here named.

It is but just to allow the Geologist time to mature his results, before finding fault that he has not done more.

In this State we have thus far had constant interruptions and no one has been allowed to carry out to completion any branch of the survey. The utility of such surveys is not at this day to be questioned, after being so abundantly proved by the experience of every important State in the Union, and the united concurrence of the most intelligent nations of Europe.

But that utility can only be developed by hard work and patient study extended over a series of years.

EDWARD DANIELS.